Pistonless Pumps for Nanosat Launch and Sample Return Vehicles, Phase I

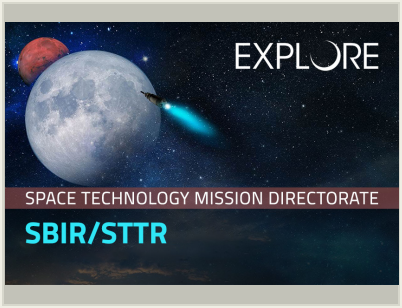
Completed Technology Project (2009 - 2009)

Project Introduction

This proposal responds to the request for pumps for pressure-fed propulsion systems with a pistonless pump wherein a pressurant act directly on the propellant(s) in a set of pump chambers. The pump system will work for both in-space and spacecraft descent and ascent systems, and it is applicable to nanosat launch vehicle (NLV) technologies as well. When integrated into a full propulsion system, this pump will increase payload mass fraction, reliability, safety, and operating flexibility. The same pump can be used for the main engine, attitude control thrusters, and fuel transfer, since the pump provides variable pressure at variable flow without using extra consumables. The pistonless design avoids sliding seals, which can cause problems for piston pumps. No precision components are needed, and all active components can be redundant and/or contamination-tolerant. For space transportation or launch vehicle systems with liquid/supercritical helium and/or multi-stage autogenous pressurization, "system Isp" including pressurant and tank mass can be intermediate between gas-generator and staged combustion turbopump systems, but at much lower cost and complexity than with either of those types. The pump has already been designed, built and tested under lab conditions, pumping kerosene, liquid nitrogen and water. The performance improvements due to inclusion of the pump in various systems have already been analyzed. The purpose of this SBIR is to bring the pistonless pump technology up to a TRL 5 level and integrate it into a nanosat launch vehicle. The work to be done consists of designing, building and testing pump features for operation under vibration, acceleration and reduced absolute pressure environments. The pump will then be integrated into a prototype NLV first stage and a full duration ground test will be conducted. If the budget is sufficient, we will conduct a flight test to 50,000 ft. The flight test pump and data will be delivered to NASA

Anticipated Benefits

A pump system was sold to a sounding rocket system developer; unfortunately the system could not be finished before they ran out of money. It offers reduced development time and increased performance over gas generator turbopumps for launch vehicles of any size, it offers advantages for manned suborbital vehicles in terms of crew safety and it offers reduced cost as compared to moderate to large size COPV pressure fed systems. This pump system allows for ascent propulsion, which requires high thrust and it can also support lower thrust course correction and attitude control burns. It also allows for quick throttle up and throttle down applications, as are required for manned lunar ascent vehicles. It can work with LOX, LH2, storables and all commonly used propellant combinations. A large pump can support million lb thrust or large applications with a shorter development time than a turbopump, with equivalent performance.



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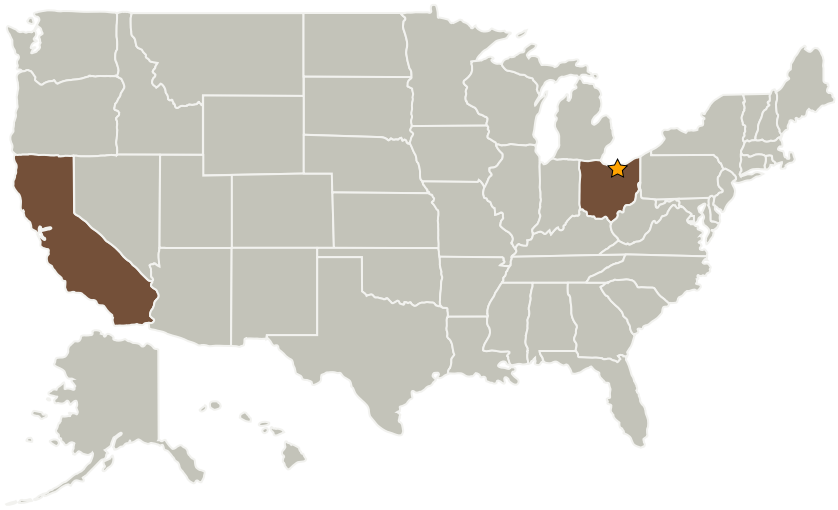
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Flometrics, Inc.	Supporting Organization	Industry	Carlsbad, California

Primary U.S. Work Locations	
California	Ohio

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Manager:

Steven J Schneider

Principal Investigator:

Steve Harrington

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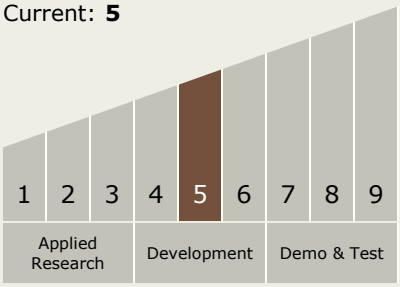
Technology Maturity (TRL)

Start: **5**
Current: **5**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.1 In-space Propellant Storage & Utilization